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PTO/SB/05 (2/98)
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UTILITY PATENT APPLICATION TRANSMITTAL (Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))	Attorney Docket No.	AMBIO/001C1
	First Inventor or Application Identifier	Van Brunt
	Title	Oscillatory Chest Compression Device
	Express Mail Label No.	EE190318150US

APPLICATION ELEMENTS See MPEP chapter 600 concerning utility patent application contents.	ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
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<p>1. <input checked="" type="checkbox"/> * Fee Transmittal Form (e.g., PTO/SB/17) (Submit an original and a duplicate for fee processing)</p> <p>2. <input checked="" type="checkbox"/> Specification [Total Pages <u>16</u>] (preferred arrangement set forth below)</p> <ul style="list-style-type: none">- Descriptive title of the invention- Cross References to Related Applications- Statement Regarding Fed sponsored R & D- Reference to Microfiche Appendix- Background of the invention- Brief Summary of the invention- Brief Description of the Drawings (if filed)- Detailed Description- Claim(s)- Abstract of the Disclosure <p>3. <input checked="" type="checkbox"/> Drawing(s) (35 U.S.C. 113) [Total Sheets <u>3</u>]</p> <p>4. Oath or Declaration [Total Pages <u> </u>]</p> <p>a. <input checked="" type="checkbox"/> Newly executed (original or copy)</p> <p>b. <input type="checkbox"/> Copy from a prior application (37 C.F.R. § 1.63(d)) (for continuation/divisional with Box 17 completed) [Note Box 5 below]</p> <p>i. <input type="checkbox"/> DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).</p> <p>5. <input type="checkbox"/> Incorporation By Reference (useable if Box 4b is checked) The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein.</p>	<p>6. <input type="checkbox"/> Microfiche Computer Program (Appendix)</p> <p>7. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)</p> <p>a. <input type="checkbox"/> Computer Readable Copy</p> <p>b. <input type="checkbox"/> Paper Copy (identical to computer copy)</p> <p>c. <input type="checkbox"/> Statement verifying identity of above copies</p>
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ACCOMPANYING APPLICATION PARTS	
8. <input checked="" type="checkbox"/> Assignment Papers (cover sheet & document(s))	
9. <input type="checkbox"/> 37 C.F.R. § 3.73(b) Statement (when there is an assignee) <input checked="" type="checkbox"/> Power of Attorney	
10. <input type="checkbox"/> English Translation Document (if applicable)	
11. <input type="checkbox"/> Information Disclosure Statement (IDS)/PTO-1449 <input type="checkbox"/> Copies of IDS Citations	
12. <input checked="" type="checkbox"/> Preliminary Amendment	
13. <input checked="" type="checkbox"/> Return Receipt Postcard (MPEP 503) (Should be specifically itemized)	
14. <input checked="" type="checkbox"/> * Small Entity Statement(s) <input type="checkbox"/> Statement filed in prior application, Status still proper and desired (PTO/SB/09-12)	
15. <input type="checkbox"/> Certified Copy of Priority Document(s) (if foreign priority is claimed)	
16. <input type="checkbox"/> Other:	

* NOTE FOR ITEMS 1 & 14: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

17. If a **CONTINUING APPLICATION**, check appropriate box, and supply the requisite information below and in a preliminary amendment:

☒ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: 082 / 661,931

Prior application information: Examiner J. Clark Group / Art Unit: 3302

18. CORRESPONDENCE ADDRESS					
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Signature	<i>David B. Edgeworth</i>	Date	3/16/98

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FEE TRANSMITTAL

Patent fees are subject to annual revision on October 1.

These are the fees effective October 1, 1997.

Small Entity payments must be supported by a small entity statement, otherwise large entity fees must be paid. See Forms PTO/SB/09-12.

See 37 C.F.R. §§ 1.27 and 1.28.

TOTAL AMOUNT OF PAYMENT (\$)**435.00****Complete if Known**Application Number **unknown**Filing Date **3/16/98**First Named Inventor **Van Brunt**

Examiner Name

Group / Art Unit

Attorney Docket No. **AMBITO/001C1****METHOD OF PAYMENT (check one)**

- 1.
- ☐
- The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit
Account
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Deposit
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Fee Required Under
37 C.F.R. §§ 1.16 and 1.17☐ Charge the Issue Fee Set in
37 C.F.R. § 1.18 at the Mailing
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- 2.
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☒ Check ☐ Money
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Large Entity Fee Code	Small Entity Fee Code	Fee Description	Fee Paid
101 790	201 395	Utility filing fee	395
106 330	206 165	Design filing fee	
107 540	207 270	Plant filing fee	
108 790	208 395	Reissue filing fee	
114 150	214 75	Provisional filing fee	

SUBTOTAL (1) (\$)**395****2. EXTRA CLAIM FEES**

Total Claims	Extra Claims	Fee from below	Fee Paid
19	20**	0	0
Independent Claims	2	3**	0
Multiple Dependent			

**or number previously paid, if greater; For Reissues, see below

Large Entity Fee Code	Small Entity Fee Code	Fee Description	Fee Paid
103 22	203 11	Claims in excess of 20	
102 82	202 41	Independent claims in excess of 3	
104 270	204 135	Multiple dependent claim, if not paid	
109 82	209 41	** Reissue independent claims over original patent	
110 22	210 11	** Reissue claims in excess of 20 and over original patent	

SUBTOTAL (2) (\$)**395****FEE CALCULATION (continued)****3. ADDITIONAL FEES**

Large Entity Fee Code	Small Entity Fee Code	Fee Description	Fee Paid
105 130	205 65	Surcharge - late filing fee or oath	
127 50	227 25	Surcharge - late provisional filing fee or cover sheet.	
139 130	139 130	Non-English specification	
147 2,520	147 2,520	For filing a request for reexamination	
112 920*	112 920*	Requesting publication of SIR prior to Examiner action	
113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action	
115 110	215 55	Extension for reply within first month	
116 400	216 200	Extension for reply within second month	
117 950	217 475	Extension for reply within third month	
118 1,510	218 755	Extension for reply within fourth month	
128 2,060	228 1,030	Extension for reply within fifth month	
119 310	219 155	Notice of Appeal	
120 310	220 155	Filing a brief in support of an appeal	
121 270	221 135	Request for oral hearing	
138 1,510	138 1,510	Petition to institute a public use proceeding	
140 110	240 55	Petition to revive - unavoidable	
141 1,320	241 660	Petition to revive - unintentional	
142 1,320	242 660	Utility issue fee (or reissue)	
143 450	243 225	Design issue fee	
144 670	244 335	Plant issue fee	
122 130	122 130	Petitions to the Commissioner	
123 50	123 50	Petitions related to provisional applications	
126 240	126 240	Submission of Information Disclosure Stmt	
581 40	581 40	Recording each patent assignment per property (times number of properties)	40
146 790	246 395	Filing a submission after final rejection (37 CFR 1.129(a))	
149 790	249 395	For each additional invention to be examined (37 CFR 1.129(b))	

Other fee (specify) _____

Other fee (specify) _____

* Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$)**40****SUBMITTED BY**Typed or
Printed Name **David B. Edgeworth**Signature **David B. Edgeworth**Date **3/16/98****Complete (if applicable)**Reg. Number **35,862**Deposit Account
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Leslie E. Scott

1. (Amended) An apparatus for generating oscillatory air pulses in a bladder positioned about a person, comprising:

an oscillatory air flow generator, comprising

an air chamber;

a reciprocating diaphragm operably connected with the air chamber;

a rod having a first end and a second end, the first end operably connected with the diaphragm, and the rod extending generally orthogonal to the diaphragm;

a crankshaft operably connected with the second end of the rod and extending generally orthogonal to the rod; and

a first motor operably connected with the crankshaft, the first motor including an armature axially aligned with the crankshaft;

a positive air flow generator operably connected with the oscillatory air flow generator;
and

control means operably connected with the oscillatory air flow generator and operably connected with the positive air flow generator for controlling the peak pressure generated by the positive air flow generator.

2. (Amended) The apparatus of claim 1 further comprising means for connecting the oscillatory air flow generator with [the] a bladder.

4. (Amended) The apparatus of claim [3] 1, wherein the control means comprises a first feedback circuit for causing the oscillatory air flow generator to generate air pulses at a predetermined frequency.

6. (Amended) The apparatus of claim 4 [wherein the predetermined oscillation rate is user-selectable] further comprising a frequency selector, allowing a user to select the predetermined frequency.

10. (Amended) The apparatus of claim 8 [wherein the peak pressure is user-selectable] further comprising a pressure selector, allowing a user to select the predetermined peak pressure.

Please add the following new claims.

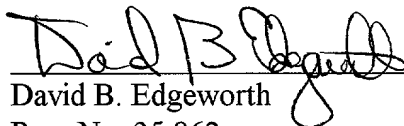
20. (New) The apparatus of claim 1, further comprising a seal extending from an outer periphery of the diaphragm to a wall of the air chamber, the seal comprising first and second generally opposed disks defining an annular region for receiving air, and a pump operably connected with the annular region, the pump maintaining the air pressure in the annular region greater than the peak pressure generated in the air chamber.
21. (New) The apparatus of claim 1, wherein the first motor operates at a speed sufficient to maintain the minimum frequency of the oscillatory air flow generator at about five hertz.
22. (New) The apparatus of claim 1, wherein the first motor rotates continuously during operation of the apparatus.

Remarks

Applicants respectfully submit that the claims, as amended, are patentable over the prior art cited in the parent application (serial no. 08/661,931), namely, Hansen (U.S. Patent 5,453,081) and Hayek (U.S. Patent 4,815,452). Claim 1, as amended, recites structure that is not found in Hansen or Hayek. The new claims and amendments add no new matter.

Respectfully submitted,

Date: 3-16-98


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APPLICATION

FOR

UNITED STATES LETTERS PATENT

TITLE: OSCILLATORY CHEST COMPRESSION DEVICE

APPLICANTS: Nicholas P. Van Brunt and Donald J. Gagne

CERTIFICATE OF EXPRESS MAIL

"Express Mail" mailing label number EE190318150US

Date of Deposit 3/16/98

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Leslie E. Scott

valve-operated, open-loop system that requires the patient to interact with the system throughout the treatment period.

Other systems include mechanical vibrators. Some vibrator systems are attached to the person's torso, while
5 others are hand-held. Vibrators and other direct mechanical compression devices are likely to be heavier than pneumatic compression devices.

A chest compression device, as is the case with medical devices generally, must meet a variety of
10 requirements. First, the chest compression device must be safe to operate. The patient receiving treatment should not be able to adjust the device to create unsafe treatment conditions. Failure of device components must not create unsafe conditions. The chest compression device should
15 provide some user control, allowing the device to be customized to the needs of individual users. The device should be easy to understand and operate by the user; detailed training and complicated controls increase the cost of the treatment. Finally, the device should minimize
20 intrusion into the daily activities of the user.

Summary of the Invention

The present invention is directed to an oscillatory chest compression device that loosens and assists in expulsion of secretions in a person's lungs. A vest,
25 containing a bladder, is secured to a patient's upper torso. One or more tubes connect the bladder with a generator. The generator includes a first, oscillatory air flow generator. A second, positive air flow generator is operably connected with the oscillatory air flow generator. Feedback systems
30 control both the oscillatory air flow generator and the positive air flow generator, providing treatment at user-selected parameters and preventing unsafe conditions.

5 The inventors of the present invention were the
first to recognize several design aspects that result in an
efficacious, safe, and easy-to-use oscillatory chest
compression device. The oscillatory air flow generator
includes a reciprocating diaphragm. The reciprocating
diaphragm delivers a generally constant pressure throughout
the range of oscillation frequencies, providing efficacious
treatment throughout the range of user-selectable frequency
settings. The reciprocating diaphragm provides a more
10 efficient transfer of electrical energy to pneumatic energy
as compared to prior rotary-valve designs.

One major safety concern in a pneumatic chest
compression device is over-pressurization of the bladder.
The reciprocating diaphragm provides inherently safe
15 pressure conditions. The only way a reciprocating diaphragm
can increase pressure in the bladder is to increase the
diaphragm stroke length or diameter. However, there is no
failure mode that will increase the stroke length or
diameter of the reciprocating diaphragm.

20 The present invention includes a positive air flow
generator operably connected with the oscillatory air flow
generator. The positive air flow generator compensates for
any leakage in the system, including the hoses and bladder.
Also, the positive air flow generator, in connection with a
25 feedback system, maintains the desired peak pressure
delivered by the bladder, independent of variations in the
bladder and the patient. The positive air flow generator
includes the safety feature of a fuse connected with the
input power. The fuse is rated so as to prevent a power
30 surge from causing the positive air flow generator to
generate an unsafe, high pressure.

The oscillatory chest compression device of the
present invention is automated, allowing the user to select

operating parameters for a treatment and then direct his attention to other matters. The feedback systems of the present invention maintain the user-selected parameters during the treatment. The user controls are selected so
5 that the user cannot select operating parameters that would result in unsafe chest compression treatment.

Other advantages and features will become apparent from the following description and claims.

Brief Description of the Drawings

10 These and other aspects of the present invention will be described in detail with respect to the accompanying drawings, in which:

Figure 1 is an illustration of a person and a chest compression device;

15 Figure 2 is a schematic diagram of the control panel of a chest compression device;

Figure 3 is a schematic diagram of a chest compression device; and

20 Figure 4 is a schematic diagram of a portion of a chest compression device.

Detailed Description of the Embodiments

A chest compression device is shown in Figure 1. A vest 1 is secured about the torso of a patient. A bladder 2 is fitted within vest 1. Oscillatory air pulses are
25 delivered to bladder 2. The outer surface of vest 1 is made of a non-stretch material, causing the expansions and contractions of bladder 2 to occur generally adjacent the patient's torso. The expansions and contractions create a pneumatic, oscillatory compression of the patient's torso to
30 loosen and assist the expulsion of mucous and other secretions in the patient's lungs. Suitable vests are available from American Biosystems, Inc., St. Paul, Minnesota, the assignee of the present invention.

5 Tubes 3 connect bladder 2 with generator 4. Two tubes 3 are shown in Figures 1 and 3; however, the number of tubes 3 may be varied depending on the desired operating parameters of bladder 2. Generator 4 generates oscillatory air pulses in accordance with user-selected settings. The pulses are converted into compressions of the patient's torso by bladder 2. Generator 4 may be configured as a mobile unit with handle 5 and wheels 6, or as a stationary unit.

10 Generator 4 includes a control panel 7, shown in Figure 2. Timer 8 allows the user to select a treatment period. Frequency selector 9 allows the user to select the frequency of compressions. In one embodiment, the frequency range is about five to twenty-five Hz. Pressure selector 10
15 allows the user to select the peak pressure for each oscillation. In one embodiment, the pressure range is about 0.2 to 0.6 PSI.

20 As shown in Figure 1, the user typically is seated during treatment. However, the user has some local mobility about generator 4, determined by the length of hoses 3. Also, the mobile unit shown in Figure 1 may be easily transferred to different locations. For treatment, the user selects the desired operating parameters and no further interaction by the user is required; generator 4 maintains
25 the user-selected parameters. The user may change the settings at any time. A remotely-operated control 11 allows the user to start and stop the treatment.

30 Generator 4 also includes a ten-minute safety timer 12. Once the user initiates treatment, safety timer 12 starts. Safety timer 12 is reset each time the user activates start/stop control 11. If the safety timer expires, generator 4 is turned off. Therefore, even if the user loses consciousness or is otherwise incapacitated,

generator 4 is turned off after a predetermined period, reducing the likelihood of injury to the user due to an excessive period of chest compressions.

A block diagram of generator 4 is shown in Figure 3.

5 Generator 4 includes two air flow units, oscillatory air flow generator 15 and positive air flow generator 16. Oscillatory air pulses are generated by oscillatory air flow generator 15. Oscillatory air flow generator 15 includes an air chamber 17. Air chamber 17 includes a wall 18 having a reciprocating diaphragm 19 suspended in an aperture 20 of wall 18 by a seal 21.

As shown in Figure 4, diaphragm 19 is a generally rigid disk assembly of two opposed, generally circular disks 22. Flexible, air-tight seal 21 is formed by two rubber disks 23 positioned between diaphragm disks 22. Diaphragm disks 22 are clamped together by bolts or other fastening means. Rubber disks 23 extend from the outer periphery 24 of diaphragm disks 22 into a groove 25 in wall 18, thereby forming a generally air-tight seal in the gap between diaphragm 19 and wall 18.

Air pressure is supplied to seal 21 by capillary tube 26, which is supplied by air pump 27 and tubing 28. Air pump 27 maintains the air pressure in seal 21 higher than the maximum pressure peaks in air chamber 17. In one embodiment, the air pressure in seal 21 is maintained at about 1.5 PSI. The pressure relationship causes rubber disks 23 to maintain the inflated shape as shown in Figure 4 as diaphragm 19 reciprocates. This results in a smooth, quiet, low-friction travel of diaphragm 19, while maintaining an air-tight seal between diaphragm 19 and wall 18.

The remaining walls 29 of air chamber 17 are generally rigid. Apertures 30 provide fluid communication

between air chamber 17 and tubes 3. Aperture 31 provides fluid communication with positive air flow generator 16. Aperture 32 provides fluid communication with the control system described below.

5 Diaphragm 19 is mechanically connected through rod 33 to a crankshaft 34, which is driven by motor 35. Each rotation of crankshaft 34 causes a fixed volume of air (defined by the area of the diaphragm multiplied by the length of the stroke) to be displaced in air chamber 17. 10 The pressure changes inside air chamber 17 resulting from the displacements are relatively small (e.g., less than one PSI) in comparison to the ambient air pressure. Therefore, there is little compression of the air in air chamber 17 and the majority of the displaced air is moved into and out of 15 bladder 2 through tubes 3 during each cycle. This results in the amount of air transferred into and out of bladder 2 during each cycle being largely independent of other factors, such as the oscillation frequency and bladder size.

In one embodiment, motor 35 is a permanent magnet DC 20 brush motor. The motor speed is generally controlled by the voltage supplied to it. A 170 volt DC power supply 36 energizes power amplifier 37. Power amplifier 37 is controlled by a frequency-compensation feedback circuit 38, thereby supplying variable length pulses to motor 35. The 25 inductance of motor 35 effectively smoothes the pulses to a constant power level that is proportional to the ratio of the pulse length divided by the pulse period. Using a pulse period of 20 kHz, the pulse length controls the motor speed.

As shown in Figure 3, all of the power circuitry is 30 located on power board 39. The control circuitry is located on a separate, low-energy control board 40. The control board 40 is connected to the power board 39 by 5000-volt opto-isolators 41, 55. The high level of isolation between

the power board 39 and control board 40 provides significant shock protection for the user.

Conduit 42 conveys changes in pressure from air chamber 17 to pressure transducer 43. Pressure transducer
5 43 converts the air pressure into an oscillating electronic signal, which is then amplified by amplifier 44. The output of amplifier 44 is then processed by frequency-compensation feedback circuit 38.

Frequency-to-voltage converter 45 converts the
10 oscillating signal to a voltage level proportional to the frequency. The output of converter 45 is fed to difference amplifier 46. Difference amplifier 46 has a second input 47 representing the user-selected frequency setting. Difference amplifier 46 compares the voltage representing
15 the user-selected frequency with the voltage representing the actual frequency detected in air chamber 17. The output of difference amplifier 46 is input into pulse-width modulator 47. The output of pulse-width modulator 47 is fed through opto-isolator 41 and power amplifier 37 to motor 35,
20 thereby adjusting the speed of motor 35 and, consequently, the oscillation frequency in air chamber 17.

Reciprocating diaphragm 19 of oscillatory air flow generator 15 provides several advantages. First, the amount of air transferred into and out of bladder 2 during each
25 cycle is largely independent of the oscillation frequency setting. In prior art systems, using a constant air flow and valve configuration, less air flow was delivered at higher frequencies. Therefore, the present invention provides a more consistent air flow over the user selectable
30 frequency range. This consistency provides a more efficacious treatment.

Further, reciprocating diaphragm 19 is both efficient and safe. The substantially closed-loop

reciprocating diaphragm configuration provides a more efficient transfer of electrical energy to pneumatic energy as compared to prior art valve designs. Also, the reciprocating diaphragm provides inherently safe air flow.

5 One of the main safety concerns with bladder-type chest compression systems is over-inflation of the bladder. In a reciprocating diaphragm system, there is no net increase in pressure, i.e., the air flow on the in-stroke equals the air flow on the out-stroke. The only way to
10 increase air flow is to increase the diaphragm stroke length or the surface area of the diaphragm. In the present invention, there is no failure mode that could cause either an increased stroke length or increased diaphragm surface area. Conversely, in valve-operated pneumatic devices, a
15 malfunction of a valve may cause unsafe pressures to develop in bladder 2.

Frequency-compensation feedback system 38 serves to maintain the oscillation frequency at the user-selected value. Also, frequency selector 9 is calibrated so that
20 oscillatory air flow generator 15 operates at a maximum oscillation rate as the default value, and frequency selector 9 can only decrease the oscillation frequency. The maximum default oscillation rate is selected to be within safe parameters, therefore, the user cannot increase the
25 oscillation rate to an unsafe level.

Although diaphragm 19 approximates a perfect system in terms of displacement of air into and out of bladder 2 on each stroke, remaining parts of the closed system are less perfect. For example, bladder 2 typically leaks air at a
30 variable rate that is difficult to model. The amount of air leakage is influenced by many factors, including variations in production of the bladder, age, use, and other factors.

Also, tubes 3 and the various connections within the

system may also leak. Additionally, the air pressure delivered to bladder 2 must be varied due to the repeated inhalation and expiration of the user during treatment, and also due to the size of the particular user. Therefore, positive air pressure generator 16 is used to supply positive air pressure to the system to compensate for the above-identified variables.

Positive air flow generator 16 includes a blower 48 driven by motor 49. The speed of motor 49 is controlled by pressure-compensation feedback system 50, thereby controlling the output pressure of blower 48.

As shown in Figure 3, pressure-compensation feedback system 50 is similar to frequency-compensation feedback system 38. The output of pressure transducer 43 is fed through amplifier 44 to a pressure peak detector 51. Peak detector 51 captures the pressure waveform peaks within air chamber 17 and generates a voltage proportional to the pressure peak. This voltage is fed to difference amplifier 52.

Difference amplifier 52 includes a second input 53 representing the user-selected pressure. The difference in actual peak pressure and selected peak pressure is represented in the voltage output of difference amplifier 52 and is fed to pulse-width modulator 54. The output of pulse-width modulator 54 is fed through a second optoisolator 55 and a second power amplifier 56 on power board 39 to motor 49. Motor 49 drives blower 48 to maintain the peak pressure in air chamber 17 at the user-selected value.

One of ordinary skill in the art will recognize that the pressure in air chamber 17 may also be decreased by a flow of air from air chamber 17 into blower 48, depending on the pressure in air chamber 17 compared to the pressure

created by blower 48. In one embodiment, blower 48 may be reversible.

Positive air flow generator 16 and pressure-compensation feedback system 50 provide several advantages.

5 First, positive air flow generator 16 dynamically adjusts the peak pressure in air chamber 17 to provide a consistent peak pressure based on the user selected peak pressure, independent of leaks in the system, size of the user, condition of the bladder, and the repeated inhalation and
10 expiration of the user. Maintaining a constant peak pressure provides for increased efficacy of treatment.

Also, the user only has to make an initial pressure selection, no further interaction with generator 4 is required. The maximum peak pressure setting is selected to
15 be within a safe treatment range. As an additional safety feature, fuse 57 serves to prevent a power surge in power supply 36 from causing blower 48 to inflate bladder 2 to an unsafe pressure.

The circuit for user-operated start/stop control 11
20 and safety timer 12 are also shown in Figure 3. In one embodiment, control 11 is a pneumatic switch of known construction. In other embodiments, control 11 may be electronic or electro-mechanical. Actuation of control 11 serves to reset safety timer 12 and also control pulse width
25 modulators 47, 54. The AND gate 60 requires that safety timer 12 be active (i.e., not zero) and control 11 be ON in order for generator 4 to create air pulses.

It is important to note the general ease-of-use provided by the present invention. To initiate treatment,
30 the user simply puts on vest 2 and selects operating parameters on control panel 7, very little training is required. This helps keep down the total cost of the

treatment. Also, the user is not required to constantly interact with the device during treatment.

Other embodiments are within the scope of the following claims.

Parameter	Unit	Value	Standard Error	t-Statistic	p-Value
Intercept		1.0000	0.0000	1.0000	0.0000
Age	Years	0.0000	0.0000	0.0000	0.0000
Gender		0.0000	0.0000	0.0000	0.0000
Marital Status		0.0000	0.0000	0.0000	0.0000
Education	Years	0.0000	0.0000	0.0000	0.0000
Income	USD	0.0000	0.0000	0.0000	0.0000
Health		0.0000	0.0000	0.0000	0.0000
Smoking		0.0000	0.0000	0.0000	0.0000
Alcohol		0.0000	0.0000	0.0000	0.0000
Exercise		0.0000	0.0000	0.0000	0.0000
Stress		0.0000	0.0000	0.0000	0.0000
Family Size		0.0000	0.0000	0.0000	0.0000
Work Hours	Hours/Week	0.0000	0.0000	0.0000	0.0000
Job Satisfaction		0.0000	0.0000	0.0000	0.0000
Life Satisfaction		0.0000	0.0000	0.0000	0.0000
Overall Health		0.0000	0.0000	0.0000	0.0000
Depression		0.0000	0.0000	0.0000	0.0000
Loneliness		0.0000	0.0000	0.0000	0.0000
Resilience		0.0000	0.0000	0.0000	0.0000
Optimism		0.0000	0.0000	0.0000	0.0000
Gratitude		0.0000	0.0000	0.0000	0.0000
Forgiveness		0.0000	0.0000	0.0000	0.0000
Compassion		0.0000	0.0000	0.0000	0.0000
Kindness		0.0000	0.0000	0.0000	0.0000
Generosity		0.0000	0.0000	0.0000	0.0000
Patience		0.0000	0.0000	0.0000	0.0000
Humility		0.0000	0.0000	0.0000	0.0000
Modesty		0.0000	0.0000	0.0000	0.0000
Meekness		0.0000	0.0000	0.0000	0.0000
Gentleness		0.0000	0.0000	0.0000	0.0000
Mildness		0.0000	0.0000	0.0000	0.0000
Peacefulness		0.0000	0.0000	0.0000	0.0000
Calming		0.0000	0.0000	0.0000	0.0000
Tranquility		0.0000	0.0000	0.0000	0.0000
Serenity		0.0000	0.0000	0.0000	0.0000
Harmony		0.0000	0.0000	0.0000	0.0000
Balance		0.0000	0.0000	0.0000	0.0000
Stability		0.0000	0.0000	0.0000	0.0000
Consistency		0.0000	0.0000	0.0000	0.0000
Reliability		0.0000	0.0000	0.0000	0.0000
Trustworthiness		0.0000	0.0000	0.0000	0.0000
Integrity		0.0000	0.0000	0.0000	0.0000
Honesty		0.0000	0.0000	0.0000	0.0000
Openness		0.0000	0.0000	0.0000	0.0000
Transparency		0.0000	0.0000	0.0000	0.0000
Authenticity		0.0000	0.0000	0.0000	0.0000
Genuineness		0.0000	0.0000	0.0000	0.0000
Sincerity		0.0000	0.0000	0.0000	0.0000
Truthfulness		0.0000	0.0000	0.0000	0.0000
Reliability		0.0000	0.0000	0.0000	0.0000
Dependability		0.0000	0.0000	0.0000	0.0000
Accountability		0.0000	0.0000	0.0000	0.0000
Responsibility		0.0000	0.0000	0.0000	0.0000
Commitment		0.0000	0.0000	0.0000	0.0000
Dedication		0.0000	0.0000	0.0000	0.0000
Devotion		0.0000	0.0000	0.0000	0.0000
Loyalty		0.0000	0.0000	0.0000	0.0000
Fidelity		0.0000	0.0000	0.0000	0.0000
Constancy		0.0000	0.0000	0.0000	0.0000

Claims

What is claimed is:

1. An apparatus for generating oscillatory air pulses in a bladder positioned about a person, comprising:
 - 5 an oscillatory air flow generator;
 - a positive air flow generator operably connected with the oscillatory air flow generator; and
 - control means operably connected with the oscillatory air flow generator for controlling the frequency
 - 10 of the oscillatory air flow generator and operably connected with the positive air flow generator for controlling the peak pressure generated by the positive air flow generator.
2. The apparatus of claim 1 further comprising means for connecting the oscillatory air flow generator with the
- 15 bladder.
3. The apparatus of claim 1 wherein the oscillatory air flow generator comprises:
 - an air chamber;
 - a reciprocating diaphragm operably connected with
 - 20 the air chamber; and
 - a first motor operably connected with the diaphragm.
4. The apparatus of claim 3, wherein the control means comprises a first feedback circuit for causing the oscillatory air flow generator to generate air pulses at a
- 25 predetermined frequency.
5. The apparatus of claim 4 wherein the first feedback circuit comprises:
 - means for detecting the oscillation rate in the air chamber;
 - 30 means for comparing the detected oscillation rate with a predetermined rate; and

means for adjusting the oscillatory air flow generator so that the detected oscillation rate approximately equals the predetermined rate.

6. The apparatus of claim 4 wherein the predetermined oscillation rate is user-selectable.

7. The apparatus of claim 1 wherein the positive air flow generator comprises a blower, and a second motor operably connected with the blower.

8. The apparatus of claim 7, wherein the control means further comprises a second feedback circuit for causing the positive air flow generator to maintain a predetermined peak pressure in the oscillatory air pulses.

9. The apparatus of claim 8 wherein the second feedback circuit comprises:

means for detecting the peak pressure in the air chamber;

means for comparing the detected peak pressure with a predetermined value; and

means for adjusting the positive air flow generator so that the detected peak pressure equals the predetermined value.

10. The apparatus of claim 8 wherein the predetermined peak pressure is user-selectable.

11. The apparatus of claim 7 further comprising means connected to the second motor for preventing the second motor from operating the blower above a predetermined pressure.

12. The apparatus of claim 11 wherein the means for preventing comprises a fuse.

13. The apparatus of claim 1, further comprising a remote start/stop control operably connected with the control means.

14. The apparatus of claim 13 further comprises a timer operably connected with the remote start/stop control.

15. A method for generating oscillatory air pulses in a bladder positioned about a person, comprising:

- 5 generating an oscillatory air flow;
- controlling the oscillatory air flow to provide a predetermined frequency;
- generating a positive air flow; and
- controlling the peak pressure of the positive air
- 10 flow to provide a predetermined peak pressure.

16. The method of claim 15 wherein the step of controlling the oscillatory air flow comprises:

- detecting the oscillation frequency of the oscillatory air flow; and
- 15 adjusting the oscillatory air flow to approximately equal the predetermined frequency.

17. The method of claim 15 wherein the step of controlling the positive air flow comprises:

- detecting the peak pressure of the positive air
- 20 flow; and
- adjusting the positive air flow to approximately equal the predetermined peak pressure.

18. The method of claim 15 further comprising selectively adjusting the predetermined frequency.

- 25 19. The method of claim 15 further comprising selectively adjusting the predetermined peak pressure.

OSCILLATORY CHEST COMPRESSION DEVICE

Abstract of the Disclosure

An oscillatory chest compression device includes an oscillatory air flow generator and a positive air flow generator. A first feedback system controls the oscillation rate of the oscillatory air flow generator, and a second feedback system controls the peak pressure created by the positive air flow generator.

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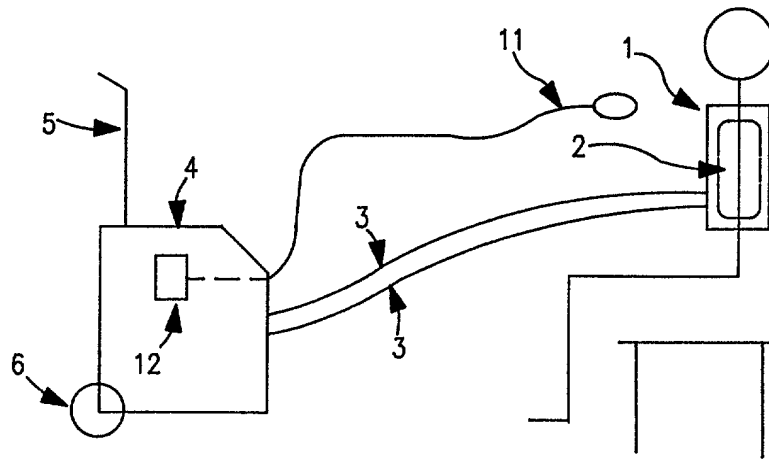


FIG. 1

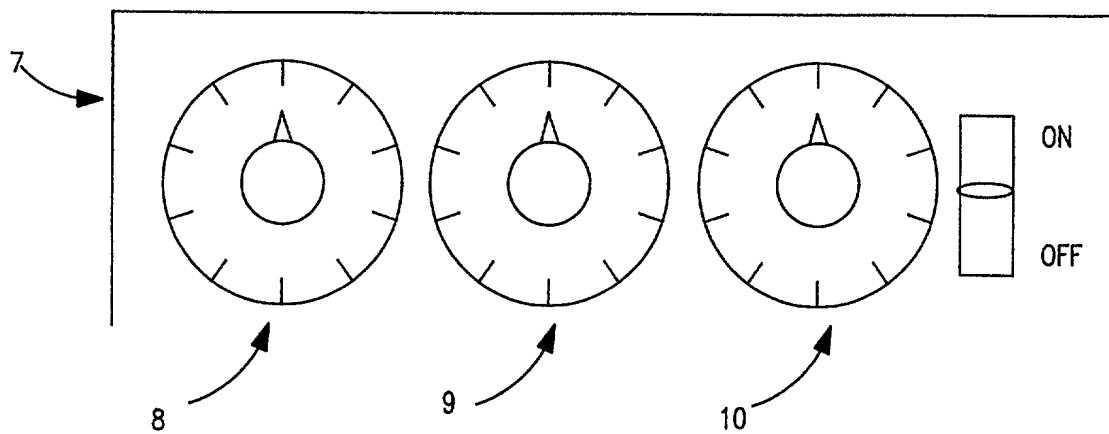


FIG. 2

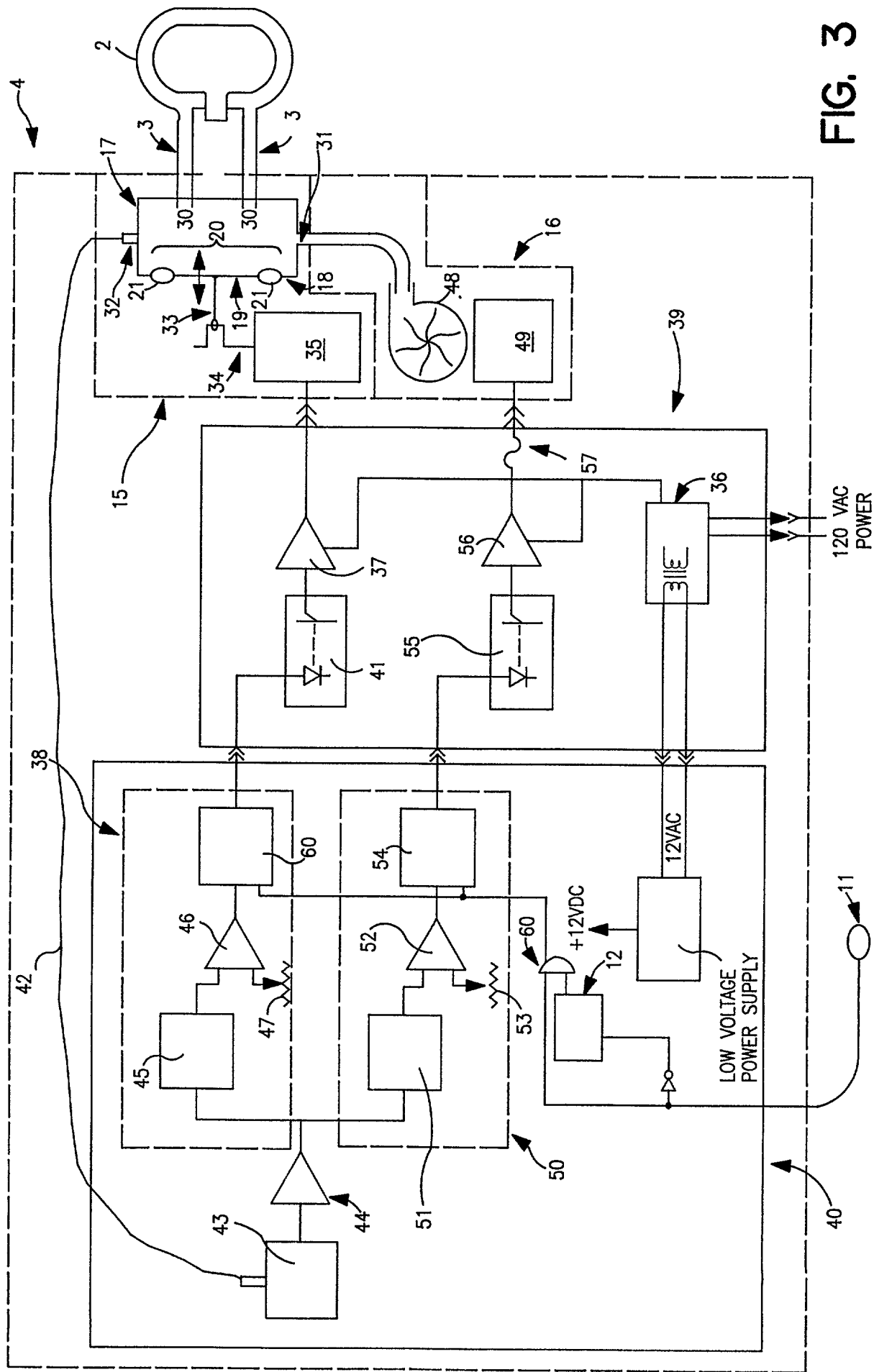


FIG. 3

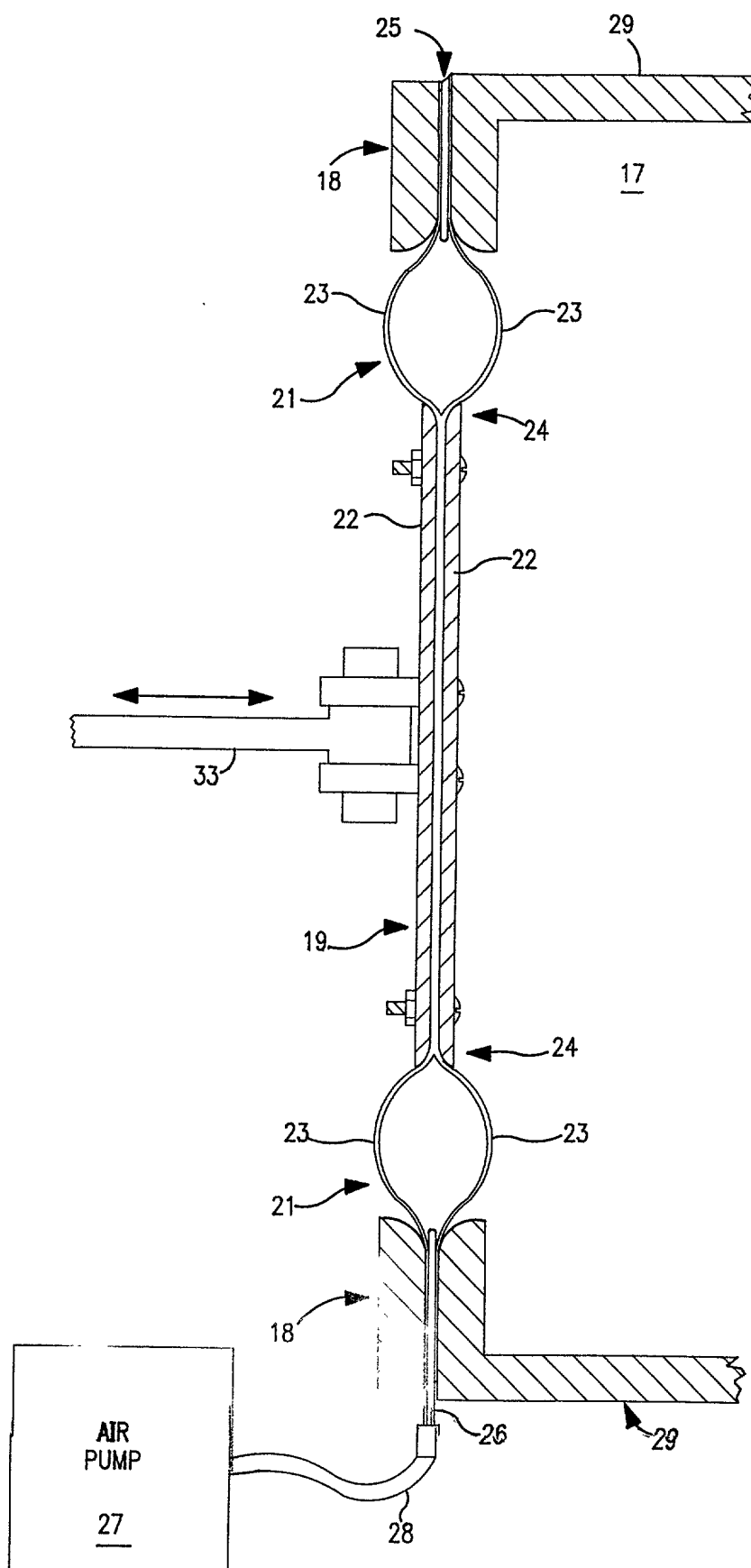


FIG. 4

Applicant: Nicholas P. Van Brunt and Donald J. Gagne
Serial No.:
Filed: Herewith
For: Oscillatory Chest Compression Device

PATENT
ATTY DOCKET NO. : AMBIO 001C

VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS-SMALL BUSINESS CONCERN

I hereby declare that I am:

- ☐ the owner of the small business concern identified below:
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

Name: American Biosystems, Inc.
Address: 20 Yorkton Court, St. Paul, MN 55117

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.12, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time, or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have conveyed to and remain with the small business concern identified above with regard to the invention, entitled OSCILLATORY CHEST COMPRESSION DEVICE by inventors Nicholas P. Van Brunt and Donald J. Gagne described in

- ☒ the specification filed herewith.
☐ application serial no. _____, filed _____.
☐ patent no. _____, issued _____.

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a non-profit organization under 37 CFR 1.9(e). *Note: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

Full Name: _____
Address: _____

- ☐ individual ☐ small business ☐ nonprofit organization

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent on which this verified statement is directed.

Signature: Elden H. Russell
Name: Elden H. Russell
Title: President
Address: 20 Yorkton Court, St. Paul, MN 55117

Date: 3-4-98

00352050

PATENT
ATTORNEY DOCKET NO: AMBIO/001C
COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled OSCILLATORY CHEST COMPRESSION DEVICE, the specification of which

(X) is attached hereto

() was filed on _____ as Application Serial No. _____
and was amended on _____.

() was described and claimed in PCT International Application No. _____
filed on _____ and as amended under PCY Article 19 on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information I know to be material to patentability in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby appoint the following attorneys and/or agents to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: David B. Edgeworth, Reg. No. 35,862.

Address all telephone calls to David B. Edgeworth at telephone number 812/824-7144.

Address all correspondence to David B. Edgeworth 7466 Ketcham Rd., Bloomington, IN 47403.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 101 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patents issued thereon.

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